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The Edward Teller Medal Lecture
High intensity lasers and the road to ignition

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Abstract

The development of high intensity lasers and the evolution of ideas and experiments for laser driven inertially confined fusion are twin themes with which my own scientific interests have been entwined for three decades.

It is interesting that ignition of fusion with lasers was first seen as requiring kilojoule energy but with more detailed study it became clear that megajoule was the realistic unit. Recently the US and French programs have embarked on building megajoule lasers with a high level of confidence in achieving ignition. In the process there has been a major shift in balance in fusion research so that ignition is now expected sooner with inertial than with magnetic confinement.

Working in an academically motivated program at the Rutherford Appleton Laboratory, it was not possible to pursue the megajoule route but new ideas in laser physics opened up the technology of ultra high intensity lasers of smaller scale which we exploited at RAL. Outstanding work by colleagues at RAL led to the glass laser CPA system Vulcan (Chris Edwards and Colin Danson) and KrF CPA and Raman laser systems Sprite then Titania (Mick Shaw and Graham Hirst) with which RAL scientists and facility user teams from UK universities and overseas conducted some of the first experiments at more than 10^{19} Wcm^{-2}. In conjunction with this class of laser developments, a concept for ignition with kilojoule energy reappeared in a new form termed fast ignition by its originator Max Tabak at the Lawrence Livermore National Laboratory.

Will fast ignition now suffer a similar cold shower of realism to that which shifted the early ignition ideas from the kilojoule to the megajoule level? My most recent task on joining LLNL is to guide experiments designed to answer this question using a new petawatt CPA beam at Nova developed by Mike Perry and colleagues, which is by an order of magnitude the most powerful laser beam available today.

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